MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2018/2019

PCM0035 – GENERAL CHEMISTRY
(Foundation in Engineering)

13 OCTOBER 2018
2.30 p.m – 4.30 p.m
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This Question paper consists of 3 pages with 3 Questions only, excluding the cover page.

2. Attempt **ALL** questions. Distribution of the marks for each question is given.

3. Please write all your answers in the Answer Booklet provided.

QUESTION 1 [20 MARKS]

(a)   Sketch the orbital diagrams for the following atom or ion.

       (i) Cr^{2+} [1 mark]
       (ii)   Cu   [1 mark]
       (iii)   Cl   [1 mark]
       [Atomic number: Cr = 24; Cu = 29; Cl = 17]

(b)   Determine if the following combinations of quantum numbers (n, l, m_l, m_s) are acceptable. Explain your answer if the combination of quantum numbers is unacceptable.

       (i) $(3, 3, 2, +\frac{1}{2})$
       (ii) $(3, 0, 0, +\frac{1}{2})$
       (iii) $(4, 2, -3, +\frac{1}{2})$
       (iv) $(3, 2, -1, -\frac{1}{2})$

                                                                     [4 marks]

(c)   For the following pairs of ions, identify the ion with smaller ionic radius. Explain your answer.

       (i) Cl^- or Br^- [1½ marks]
       (ii) Na^+ or Al^{3+} [1½ marks]
       [Atomic number: Cl = 17; Br = 35; Na = 11; Al = 13]

(d)   Bonding is a result from combining a minimum of two types of atoms. State the type of bonding (ionic, covalent or metallic) in the following compounds.

       (i)   K(s)   [1 mark]
       (ii) N_2O(g)   [1 mark]
       (iii) $MgCl$(s)   [1 mark]
       [Atomic number: K = 19; N = 7; O = 8; Mg = 12; Cl = 17]

(e)   Draw the *Lewis structures* for

       (i)   As   [1 mark]
       (ii)   Se   [1 mark]
       (iii) NO_2^- [2 marks]
       [Atomic number: As = 33; Se = 34]

(f)   Use the VSEPR model to predict the geometry and give the AB_mE_n classification for OF_2. Provide the *Lewis structure* for this molecule.
       [Atomic number: F = 9]   [3 marks]

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QUESTION 2 [15 MARKS]

(a) Define *phase change*.   [1 mark]

(b) What processes are involved with the phase changes if

    (i) I_2 vapor comes in contact with a cold surface?   [1 mark]
    (ii)   solid vaporized directly?   [1 mark]
    (iii)   dew appears on a grass in the morning?   [1 mark]

(c) (i)   What is the difference between the intermolecular forces and intramolecular forces?

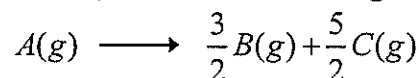   [1 mark]

    (ii)   Determine the possible types of crystal for the following compounds:

            ZnS, SO_2, CaF_2, Ba and SiO_2.
                                                               [2½ marks]
            [Atomic number: Zn = 30; S = 16; O = 8; Ca = 20; F = 9; Ba = 56; Si = 14]

(d) Referring to the reaction below, answer the following.
$$A(g) \longrightarrow \frac{3}{2}B(g) + \frac{5}{2}C(g)$$

    (i)   Express the rate of reaction in term of changing in concentration of each of the reactants and products.

                                                                  [1½ marks]

    (ii)   What is the rate of C if the rate of B is increasing at 0.025 M/s?
                                                                  [1½ marks]

    (iii)   What is the reaction order if the rate law for $A(g) = k\,[A]^{2/3}$?
                                                                    [1 mark]

    (iv)   If the rate constant k is 6.60×10^{-2} min^{-1}, determine the half-life of this decomposition.
                                                                     [1 mark]

(e) Sometimes catalyst is preferred to be used in the reaction.

    (i)   What is catalyst?   [1 mark]

    (ii)   What are the types of catalyst? Briefly discuss the difference between them.
                                                                   [1½ marks]

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QUESTION 3 [15 MARKS]

(a)   Acids and bases are classified in terms of their formulas and their behavior in solvent water (based on Arrhenius definition).

      (i)   What is the main characteristic of acids?   [1 mark]
      (ii)   What is the main characteristic of bases?   [1 mark]

(b)   Write the acid-dissociated constant (K_a) for the following acids.

      (i) HNO_2 [½ mark]
      (ii) HCO_3 [½ mark]

(c)   Calculate the pH of (i) and (ii), and pOH of (iii).

      (i) 5.04×10^{-3} M HI   [½ mark]
      (ii)   0.0111 M NAOH   [1 mark]
      (iii) 0.125 M $Ba(OH)_2$ [½ mark]

(d)   Rank the following acids in the order of decreasing acid strength (Higher strength first):

             HCl   HI   HBr   HF

                                                          [2½ marks]

(e)   Define the following.

      (i)   Redox reaction   [1 mark]
      (ii)   Electrochemistry   ·[1 mark]

(f)   Consider the electrolysis of molten barium chloride, $BaCl_2$.

      (i)   Write the balanced half-reactions at cathode and anode.

                                                    [2 marks]

      (ii)   How many grams of Ba metal can be produced by supplying 0.50 A for 30 min?

                                                    [3½ marks]

    [Atomic mass of Ba = 137.3 ; Faraday constant = 96,500 C/mol e⁻]

End of Paper